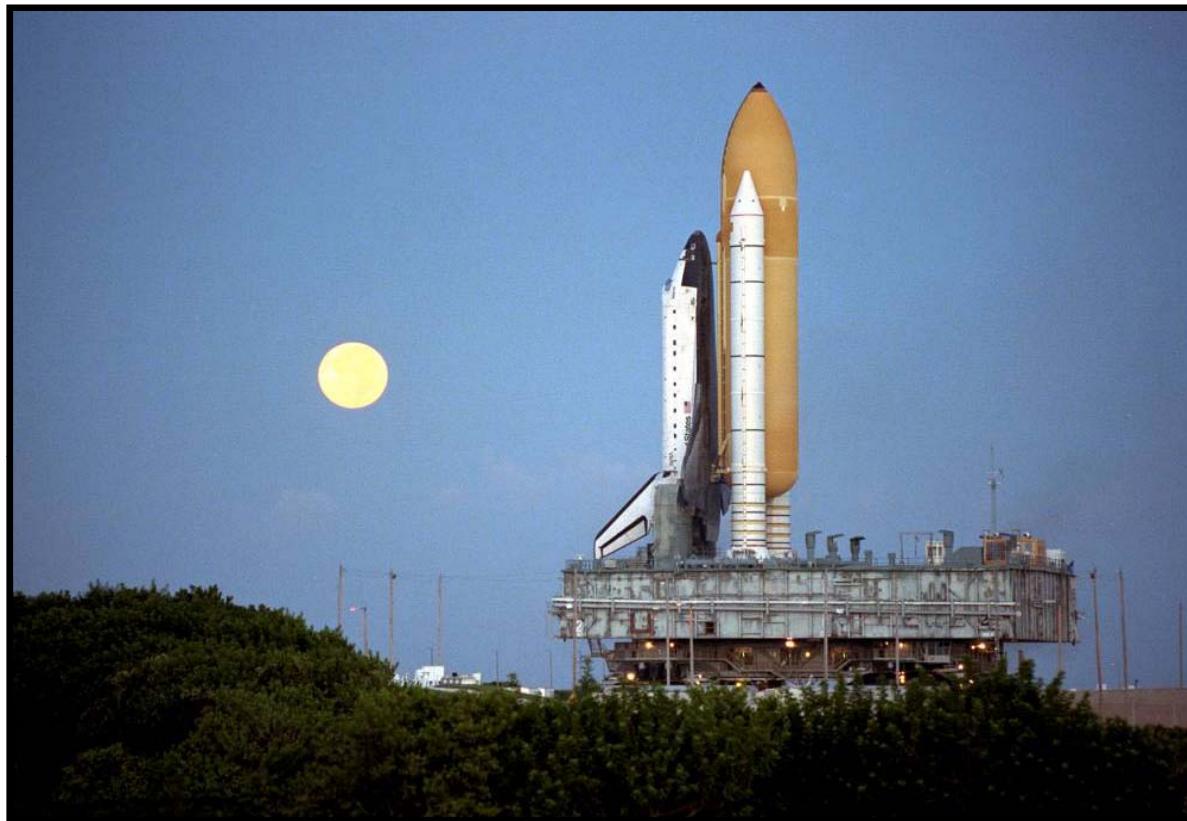




**SPACE SHUTTLE PROGRAM**  
**Shuttle Propulsion Office (MSFC)**  
NASA Marshall Space Flight Center, Huntsville, Alabama



## **PROGRAM ENVIRONMENTAL ASSURANCE SHUTTLE ENVIRONMENTAL ASSURANCE AND THE FUTURE**

Steve Glover

Propulsion Systems Engineering and Integration Office (PSE&I)/MSFC  
NASA Environmental and Energy Workshop

September 24-26, 2008

NASA Langley Research Center, Hampton, Virginia



## OVERVIEW

- SEA Team
- SEA Evolution
- Challenges to NASA Program Environmental Assurance
- SEA Technical Issues
- Environmental Assurance Implementation Challenges
- Successes
- Benefits
- Unfinished Business
- Lessons Learned
- SEA Future





## **SEA TEAM**

### **Overview**

- Material availability continues to be impacted by domestic and international environmental health and safety (EH&S) regulations, industrial pollution prevention goals and related vendor economics
- SEA is an integrated team that works to identify, communicate and address safety and environmentally driven materials obsolescence issues and pollution prevention opportunities
  - Proactively identifies potential problems, makes efficient use of resources and expertise in mitigation
  - Uses a systems focus on issues driven by current or future EH&S drivers
  - Exercises a Risk Management Approach: evaluate program risk, mitigate, track, and control identified issues



## **SEA TEAM**

### **Structure**

**Management Team**  
Civil Service and Contractor

#### **AFFECTED PROJECTS**

**Space Shuttle Program**  
Orbiter Project and Prime  
ET Project and Prime  
RSRB Project and Primes  
SSME Project and Prime  
Ground Operations and Prime  
Flight Crew Equipment and Prime  
Safety & Mission Assurance

#### **INTERFACES**

**HQ Environmental Office**  
RRAC  
TEERM

**Center Environmental Management Offices**

**Center Engineering Materials**

**Air Force Space Command**  
**Army Redstone**  
**Others**

**Tri-Program Supportability Council**

**CxP/ISS**



# SEA TEAM Risk Management Process



## IDENTIFY

HQ/RRAC

Industry Data

- Regulatory Review
- Element Input
- Notices

## CONTROL

- Close/Accept Risks
- Continue current mitigation plan or replan

## ANALYZE

- Data collection
- Sub-team if needed
- Evaluate likelihood/impact

## COMMUNICATE & DOCUMENT

- Status reports/Boards
- Advisories
- Technical Products
- SIRMA
- Meetings and Telecons

## TRACK

- Periodic risk review
- Track mitigation plans

## PLAN/MITIGATE

- SEA risk or other owner
- Formal SEA issue?
- SIRMA entry
- Accept/Mitigate/Watch
- Mitigation Plans: regulatory; stockpile, vendor track, replacement, re-qualification
- Collaboration/data sharing

HQ/RRAC/TEERM/AFSC



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**SEA TEAM: TECHNICAL ISSUES**

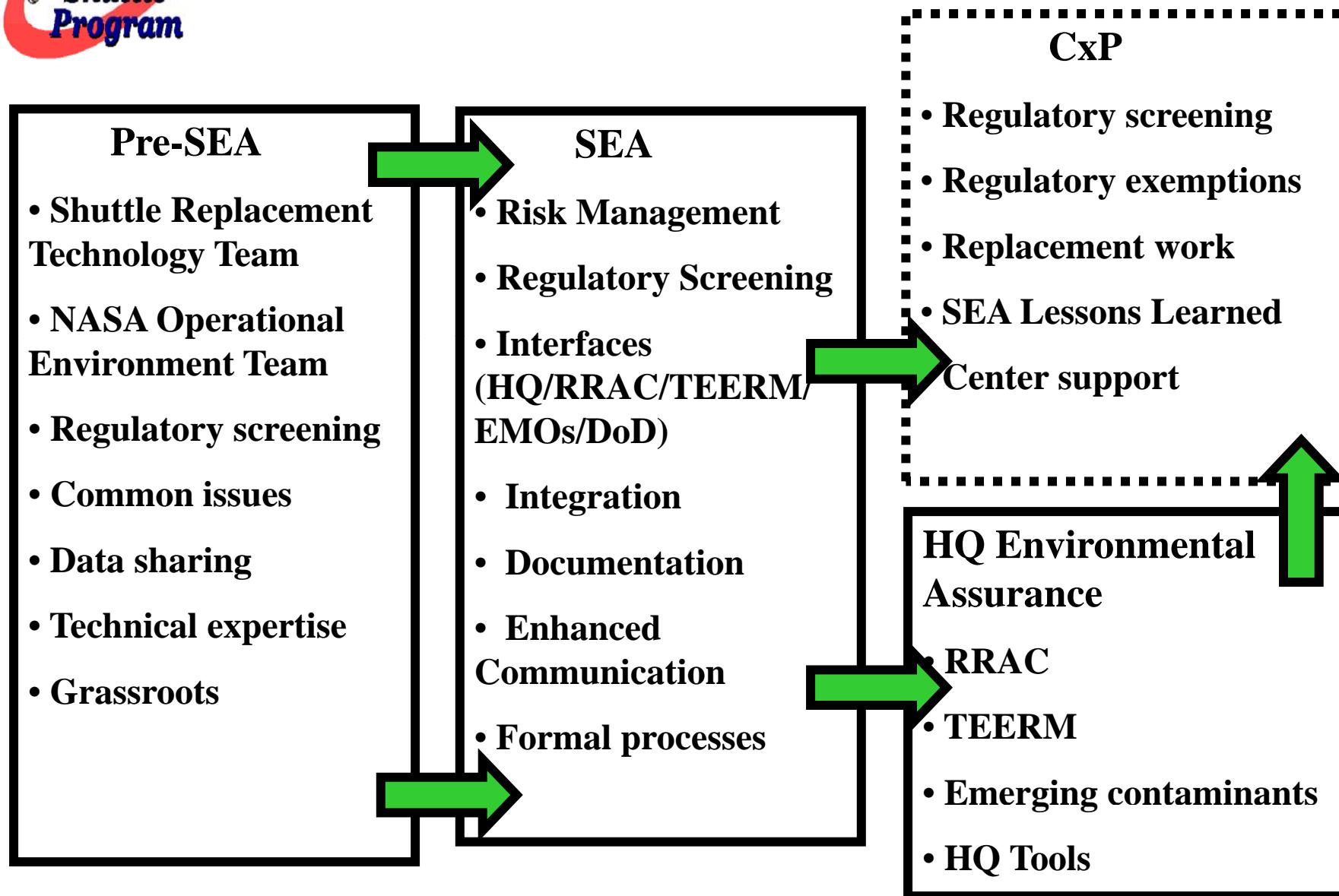


	SIRMA #	SSP 12/06 L x C	SSP 4/07 L x C	SSP 12/07 L x C	SSP 4/08 L x C
1,1,1 Trichloroethane Elimination (Orbiter use)	1018	2 x 5	3 x 4	3 x 4	3 x 4
1,1,1 Trichloroethane Elimination (RSRM use)	1019	2 x 5	1 x 5	1 x 5	1 x 5
Cadmium Replacement in Plating Applications	1020	3 x 4	2 x 3	2 x 3	2 x 3
Hexavalent Chromium Replacement in Primers	1021	3 x 4	2 x 4	2 x 4	2 x 4
Hexavalent Chromium Replacement in Conversion Coatings	1022	3 x 4	2 x 4	3 x 4	3 x 4
Chemical Paint Stripper Alternatives	1023	2 x 3	2 x 3	2 x 3	2 x 3
Alternate Dry-Film Lubricant	1024	2 x 3	2 x 3	CLOSED	CLOSED
High Volatile Organic Compound Coatings	1025	3 x 3	2 x 3	2 x 3	1 x 3
Hypalon Paint	1026	2 x 2	2 x 2	2 x 2	2 x 2
Lead-Free Electronics	1027	3 x 4	4 x 2	4 x 2	4 x 2
Hexavalent Chromium in Alkaline Cleaners	1028	2 x 3	2 x 3	2 x 3	CLOSED
Hazardous Air Pollutant Inks	1029	2 x 3	2 x 3	2 x 3	1 x 3
Methyl Ethyl Ketone	1030	CLOSED	CLOSED	CLOSED	CLOSED
Precision Cleaning and Verification Solvents	1031	2 x 3	2 x 3	CLOSED	CLOSED
Perfluoroalkyl Sulfonates	1032	3 x 2	3 x 2	CLOSED	CLOSED
Brominated Flame Retardants	1033		2 x 4	2 x 4	2 x 4
HCFC 141b Blowing Agent	2162	2 x 5	2 x 5	2 x 5	2 x 5
PFOA perfluorooctanoic acid	2823		2 x 5	2 x 5	2 x 5

L = likelihood; C = consequence



## SEA EVOLUTION





## **CHALLENGES TO NASA PROGRAM ENVIRONMENTAL ASSURANCE**

- Increase in US and State regulations, complex environment
- Increase in EU regulation and potential for impact to vendors
- Direct impact of regulations on vendors and sub-tier suppliers
- Industry decisions to proactively replace hazardous materials even before regulation, sometimes with little or no notice
- Difficult to identify drivers and evaluate risk
- Change in assumptions and direction due to SSP 2010 retirement
- Supporting Missions: operational vs. development; SOMD vs. ESMD; multiple project life stages



## **ENVIRONMENTAL ASSURANCE IMPLEMENTATION CHALLENGES**

- Confusion: environmental tasks, roles and responsibilities
  1. Environmental Assurance vs. Environmental compliance and NEPA
  2. Environmental Assurance Roles (Program/HQ/RRAC/TEERM/Centers)
  3. Materials vs. Environmentally driven materials obsolescence
- Confusion: SEA work/ownership of issues vs. SEA facilitated communication and discussion
- Many unique environmental assurance products
- Some difficulty getting contractors to share data, SSP elements report relevant work
- Sometimes team is out of the loop until something becomes an issue
- SSP focus is obsolescence – hard to justify Pollution Prevention work (depends on project life cycle)
- Difficulty in identifying if and where an at risk material is used in SSP
- Proactive identification of drivers is difficult (particularly industry drivers)
- Application of risk assessment scorecard and SIRMA process to multiple element, multiple impacts, multiple opinions, long term risk with high uncertainty
- Uncertainty concerning SEA future makes planning difficult



## SUCCESSES

- SEA Team: available expertise to address materials and environmental issues, provide technical feedback to SSP, CxP and HQ
- Face to face meetings: communication, data sharing, interfaces, team building
- Interfaces: HQ, RRAC, TEERM, EMOs, AFSC
- Communication: Notices, products, meetings
- Reporting: annual report, status report, monthly updates
- Risk Management approach: standard approach to risk assessment, SIRMA
- Success using technical sub-teams to address specific issues
- Success working with HQ on regulatory input and reviews
- Team is comfortable bringing up any issue; success in communicating to risk owners outside of SEA team
- SEA Issues
  - HFC 141b: reporting and coordination with HQ, RRAC, CxP, Primes
  - Lead free electronics: identified SSP risks, element specific mitigation strategies
  - PFOA: identified vendor-driven risk, sub-team working with industry to evaluate risk
  - Risks closed: Alternate Dry Film Lubricant  
Hexavalent Chromium in Alkaline Cleaners  
Methyl Ethyl Ketone  
Precision Cleaning and Verification Solvents  
Perfluoroalkyl Sulfonates



## BENEFITS

SEA is reducing risk to the SSP associated with environmentally driven materials obsolescence by:

- Identifying regulatory impacts
- Working with regulators to minimize the adverse impact of regulatory restrictions
- Maintaining essential use exemption
- Providing notice and technical support concerning vendor changes and materials concerns
- Sharing material replacement data and working mitigation efforts
- Communicating potential issues and risks to management and other technical forums
- Interfacing with DoD and other agencies to share data/collaborate
- Identifying and mitigating environmental and material obsolescence concerns

Constellation, ISS and other Projects have benefited from established SEA activities

- HCFC 141b process and products greatly supported CxP exemption
- Regulatory matrix and review process in place
- Common issues and risk assessments
- Established team of expert contacts



## UNFINISHED BUSINESS

- Major replacement work mostly terminated, stockpiling and vendor tracking instead
- Regulatory focus on near-term risks, no review of regulations with potential impact after 2010
- No regulatory mitigation planned past 2010
- Reduced resources, reduced reporting planned through 2010
- Expanding interfaces
- Major risk assessment process improvements



## LESSONS LEARNED

- Effective program environmental assurance requires:
  - established requirements and management processes
  - management support and adequate resources
  - proactive, action orientation
  - committed and strong program, management, environmental, material, and regulatory team
  - ongoing documentation
- Effective approach includes:
  - systems focus and dedicated interdisciplinary team
  - risk management approach
  - proactive regulatory processes
  - effective communication and active interfaces
  - materials and environmental technical expertise
  - integrated technical and project management expertise



## LESSONS LEARNED

- Multiple programs with interdependent and overlapping issues should coordinate to avoid mission impacts and ensure cost-effectiveness
- All stages of a project life cycle should consider environmental discipline, including design
- Programs should be encouraged to reduce environmental footprint
- SEA identified materials to avoid or address include:
  - HCFC 141b Blowing Agent
  - 1,1,1 Trichloroethane
  - Cadmium Replacement in Plating Applications
  - Hexavalent Chromium Replacement in Conversion Coatings and Primers
  - Lead-Free Electronics
  - Perfluoroalkyl Sulfonates/Perfluorooctanoic acid
  - Brominated Flame Retardants



## SEA FUTURE

- SSP and CxP both carry risks related to loss of SEA capability
- Have had discussions with MSFC Engineering, RRAC, TEERM, HQ Environmental, CxP, SSP Propulsion Office, PSE&I, SSP Transition Team and CxP Transition Manager on need and approach to transition
- Also considered HQ or SOMD/ESMD-level team
- All agree on need for SEA like team to support CxP
- Provided PPBE input to CxP and Human Space Flight Capability exercise
- No current CxP or HQ funding support or commitment
- Current plan is to begin SEA termination along with SSP, provide data and information to CxP
- Draft SEA Transition and Retirement Plan under review



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## SEA FUTURE: COMMON RISKS

	SIRMA #	SSP 4/08 L x C	Potential CxP and/or ISS Risk
1,1,1 Trichloroethane Elimination (Orbiter use)	1018	3 x 4	NO
1,1,1 Trichloroethane Elimination (RSRM use)	1019	1 x 5	YES
Cadmium Replacement in Plating Applications	1020	2 x 3	YES
Hexavalent Chromium Replacement in Primers	1021	2 x 4	YES
Hexavalent Chromium Replacement in Conversion Coatings	1022	3 x 4	YES
Chemical Paint Stripper Alternatives	1023	2 x 3	YES
Alternate Dry-Film Lubricant	1024	CLOSED	NO
High Volatile Organic Compound Coatings	1025	1 x 3	YES
Hypalon Paint	1026	2 x 2	NO
Lead-Free Electronics	1027	4 x 2	YES
Hexavalent Chromium in Alkaline Cleaners	1028	CLOSED	YES
Hazardous Air Pollutant Inks	1029	1 x 3	YES
Methyl Ethyl Ketone	1030	CLOSED	NO
Precision Cleaning and Verification Solvents	1031	CLOSED	YES
Perfluoroalkyl Sulfonates	1032	CLOSED	YES
Brominated Flame Retardants	1033	2 x 4	YES
HCFC 141b Blowing Agent	2162	2 x 5	YES
PFOA perfluorooctanoic acid	2823	2 x 5	YES



## STEPS TOWARD FUTURE SEA

### Accomplished

- ✓ Draft SEA Transition Plan
- ✓ Begin development of SEA closeout technical documentation
- ✓ Include Ares, other CxP Projects and ISS in SEA telecons and meetings
- ✓ Share lessons learned with CxP and ISS
- ✓ Discussions with RRAC, and MSFC Engineering
- ✓ Regulatory Screening Matrix from RRAC
- ✓ Proposal and funding requirements provided to SSP, Human Space Flight and CxP management

### Next Steps

- Identify responsible organization
- Obtain funding commitment and guidance from CxP or HQ
- Develop Management Plan
- Establish requirements
- Implement activity
  - Identify and begin to work shared issues and evaluate SSP replacement work for application to CxP
  - Review recent RRAC matrices for potential operational impacts
  - Identify issues and roadblocks and begin to address (e.g. allow SSP primes to support joint SSP/Cx work)
  - Clarify HQ involvement, potential to address other programs
  - Decide on organization where team management will reside
  - Identify contract mechanism for SEA support



## **SUMMARY**

- SEA provides benefits to SSP
- CxP has a similar need, identified a risk
- SEA capability to be retired in 2010
- No CxP or HQ funding identified
- Suggestions?



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# BACKUP



## NOTIONAL TRANSITIONAL ENVIRONMENTAL ASSURANCE TEAM

**Management Team**  
Civil Service and Contractor

### AFFECTED PROJECTS

SOMD/ESMD

**Space Shuttle Program**  
Orbiter Project and Prime  
ET Project and Prime  
RSRB Project and Primes  
SSME Project and Prime  
Ground Operations and Prime  
Flight Crew Equipment and Prime  
Safety & Mission Assurance

**Constellation**  
Ares I Upper Stage – Primes; Eng Teams  
Ares I First Stage – Prime; Eng Teams  
Ares I J2X – Prime; Eng Teams  
Ares V – Prime; Eng Teams  
Orion – Prime; Eng Teams

**ISS**

### INTERFACES

**HQ Environmental Office**  
RRAC  
TEERM

**Center Environmental  
Management Offices**

**Center Engineering Materials**

**Air Force Space Command**  
**Army Redstone**  
**Others**

**Tri-Program Supportability  
Council**



## SSP ENVIRONMENTAL TASKS

NEPA (National Environmental Policy Act)	SSP (Glover)/ Centers/HQ
Environmental Compliance	Centers Primes SEA Team Interface
Environmental Remediation	Centers HQ Environmental SEA Team Interface
<b>Environmental Assurance</b>	
Identify Regulatory Changes/Negotiate with Regulatory Agencies	HQ Environmental/RRAC (Scroggins) SEA Team
Identify Industry/Market Changes	Logistics/Projects/Primes SEA Team
Program Level Environmental Assurance: Risk Management; Integration; Interfaces; Communication	SEA Lead (Glover) SEA Team
Identify/Evaluate Risks to Program and Projects	SEA Team Projects/Primes Engineering
Pollution Prevention	HQ Environmental/TEERM (Griffin) Centers SEA Team
Materials Replacement – Operations	Engineering M&P Projects/Primes SEA Team HQ Environmental/TEERM (Griffin)
Materials Replacement – Design/Testing	Engineering M&P Projects/Primes SEA Team HQ Environmental/TEERM (Griffin)